Remarks/Arguments

Claims 1-29 are in the application. Claims 1, 14, and 20 are in independent form. The specification is amended to correct typographical errors. No new matter is added. Claims 14 and 17 are amended to correct a lack of antecedent bases.

Rejections under 35 USC 102

Claims 14 and 20 stand rejected under 35 USC 102(b) as anticipated by U.S. Pat. Pub. No. 2002/0074494 by Lundquist et al. ("Lundquist"). Applicant replies as follows.

Lundquist teaches a method of processing a "flip chip." A flip chip is mounted upside down in its packaging to make direct electrical contact with contacts on the package, rather than using conventional wires from pads on the chip to pads on the package. Because the chip is mounted upside down and is bonded to its package, any modification to the circuit, such as breaking or creating conductive paths, must be performed from the backside. This necessarily entails removing a relatively great thickness of semiconductor material to reach the area of the chip on which the circuits are fabricated. Lundquist teaches accessing the circuitry from the backside using multiple steps:

1. Mechanically thinning the wafer
2. Cutting a large trench 355 (FIG. 3B) using laser chemical etching. Para. [0050].
3. Cutting a smaller trench 365 (FIG. 3C) at the bottom of the first trench 355 using chemically assisted ion beam processing. Para. [0052]. The bottom of the small trench is about 20 nm to 1000 nm away from the active diffusion region. Lundquist's invention is directed to determining when to stop milling smaller trench 365 before the hole is too close to the actual circuit.
4. Cutting a hole 375 (FIG. 3D) in the smaller trench 365 to access the circuit. Para. [0062] Lundquist teaches that conventional endpointing techniques is used to determine when to stop milling at the bottom of hole 375. Para. [0062], lines 14-17.

Thus, Lundquist teaches an endpointing method for use in a specific circumstance, that is,

for use when milling in a semiconductive material near the active diffusion layer of a reverse biased, off state transistor to which power is applied. The invention of Lundquist teaches determining the end point of milling by using the power supply leakage current input into a frequency sensitive circuit. The power supply leakage current is created by the creation of electron-hole pairs 730 in a semiconducting area near the depletion region 740. The electron hole pair creation causes current to flow in the transistor of the circuit, which is powered by the power supply. As hole 355 gets deeper and closer to the active diffusion region, more electron-holes pairs flow through the transistor, so the transistors conducts more current, and the power supply leakage current increases. At a predetermined value, the milling is stopped. Para. [0052].

Thus, Lundquist teaches a limited endpointing technique that is appropriate only when milling in a semiconducting region near an active diffusion region of a reverse biased, off transistor to approach a buried circuit. When milling to actually contact the circuit, Lundquist teaches a return to conventional milling. Para. [0068].

To support an anticipation rejection, the elements in the reference must be arranged as they are in the claim. MPEP 2131. Even where all elements are present in a reference, there is no anticipation unless the elements are arranged in the manner required by the claims. Ex parte Gould, 6 USPQ2d 1680, 1682 (Bd. Pat. App. & Inter. 1987). Claim 14 recites "the output signal including a secondary charged particle signal or a stage current." The examiner sites sect. [0057] to show that Lundquist teaches that "the output signal including [a secondary charged particle signal or] a stage current generated by the electron-hole pairs 730 entering depleted region 740 can be used to determine proper endpointing."

Lundquist does not teach a single embodiment of the invention of claims 14 and 20. Applicants submit that in Para. [0057], Lundquist teaches using the power supply leakage current, not stage current. Applicants respectfully submit that the differences between detecting the power supply leakage current and detecting the stage current is significant. Lundquist teaches that the power supply leakage current is created as the ion beam impinges in semiconducting material near the depletion region 740 to create electron-hole pairs 730 in transistors paragraph [0057], which causes current to flow in the transistor of the circuit because the circuit is powered by the power

supply. Thus, using the power supply leakage current requires making connections to pins of the chip and powering the circuit. Using the stage current does not require powering the circuit and does not require making an electrical connection to the circuit itself. Moreover, Lundquist teaches that use of power supply leakage current is limited to the ion beam impinging in semiconductor material in the vicinity of a reverse biased, off state transistor. Para. [0081]-[0083]

Lundquist does mention that the prior art uses a stage current. Para. [0015]. Lundquist, however. teaches against using the stage current in his embodiment, stating: "These techniques all rely on a signal change at a material boundary or interface and are difficult to apply to backside operations where milling often must be reliably stopped before diffusion regions are perturbed where there is no meaningful materials interface but merely a change in doping impurity concentration." Lundquist, para. [0015], lines 7 - 13.

Thus, not only does Lundquist not teach a single embodiment of his invention that uses the stage current with a frequency sensitive detector circuit, he teaches against the combination. Applicants respectfully request, therefore, that the rejection of claim 14 be withdrawn

Applicants submit that claims 15-29 are allowable for the reasons described above with respect to claim 14.

Regarding claim 20, the Examiner states that the limitation of modulating signal is the same as periodically pulsing or blanking the beam. Applicants submit that claim 20 recites "applying a modulating signal to a conductor within the work piece being processed." Lundquist's paragraph [0058] teaches modulating the ion beam, not a conductor within the work piece.

The Examiner states that in claims 15 and 16 are inherently cited paragraph [0058] lines 1-3. Applicants submit that in that paragraph, Lundquist teaches a technique for determining when the ion beam approaches an active diffusion region of a reverse biased transistor, and does not teach determining when an element is exposed or severed. Lundquist teaches the cessation of milling when the power supply leakage current reaches a certain level in milling hole 365, and then the return to convention endpointing techniques for the final milling of hole 375 to contact the circuit.

With regard to claims 18 and 27, applicants submit that the Examiner is using elements

from different embodiments and therefore the anticipation rejection is improper. Lundquist teaches that the prior art uses secondary electrons (para. [0016]), but points out its shortcomings. Lundquist instead using the power supply leakage current.

Rejections under 35 USC 103(a)

In rejecting the claims, MPEP 2141 requires:

"(A) The claimed invention must be considered as a whole;

(B) The references must be considered as a whole and must suggest the desirability and thus the obviousness of making the combination; [and]

(C) The references must be viewed without the benefit of impermissible hindsight vision afforded by the claimed invention."

Applicant submits that considering Lundquist as a whole, Lundquist does not suggest the desirability of modifying his embodiments to produce the claimed invention. Lundquist teaches a specific technique useful only in limited circumstances, that is, in a semiconducting material near the active diffusion region of a powered, reverse biased, off state transistor. Para. [0082]. He teaches returning to conventional techniques to determine the endpoint when approaching the actual circuit. Para. [0068].

Claim 24 stands rejected under 35 USC. 103(A) for obviousness over Lundquist in view of general knowledge in the art. The Examiner states that Lundquist shows all the limitation of claim 24 as applied to claim 20 and that the additional limitation of claim 24 is "generally known in the art." The Examiner states that "it is also generally known in the art that a modulation frequency should not exceed the ion beam repetition frequency, whereby the number ½ is not critical." MPEP 2144.03(A) states: "It would not be appropriate for the examiner to take official notice of facts without citing a prior art reference where the facts asserted to be well known are not capable of instant and unquestionable demonstration as being well-known. For example, assertions of technical facts in the areas of esoteric technology or specific knowledge of the prior art must always be supported by citation to some reference work recognized as standard in the pertinent art."

Applicants explain in para. 1043, lines 1-5: "The frequency of the modulation is preferably

chosen to be within two constraints. First, the frequency of modulation, f, is preferably less than half the ion beam frequency, f_c, that is, $f < 0.5\ f_c$. This allows at least two samples of beam induced secondary emission signal to be captured per modulation period." As such, the number one-half is not arbitrary but is related to optimized functioning of the invention in some embodiments.

The Examiner provides no evidence or reasoning to explain why the modulation frequency applied to the conductor in the work piece should be limited by the ion beam frequency or why it should be less than ½ the ion beam frequency. If the Examiner persists in the rejection, applicant respectfully requests that a reference be provided as required in MPEP 2144.03(C).

With regard to claim 29, applicants submit that claim 29 is patentable for the reasons described above with respect to claim 20 and claims 18 and 27. Moreover, the Examiner states that "the limitations of (a) sampling the stage current generated by the CPB and (b) monitoring the secondary electron signal, as two viable techniques for FIB endpoint detection. It would have been obvious to one of ordinary skill in the art at the time of the invention was made to mix the two techniques into 'sampling' the 'secondary electron signal', as recited in applicant's claim 29, since mixing two techniques is another alternative which is already inherent in Lundquist's teaching and is generally available to one of ordinary skill in the art without need of any auxiliary teaching."

Applicants submit that Lundquist in paragraph 15 describes monitoring the "sample stage current," that is, the current from the stage on which the sample undergoing processing rests. Lundquist does not teach "sampling" the stage current. Applicants requests therefore, that the rejection be withdrawn.

Regarding claim 1 the examiner states that claims 1-13 are unpatentable in view of Lundquist, Talbot (U.S. Pat. No. 5,140,164), or Rasmussen (U.S. Pat. No. 5,435,850). The Examiner states that Lundquist shows, either alone or in view of "general knowledge in the art" shows all the limitations of claims 1-13 except the "recitation of that the CPB is patterned, as recited in independent claim 1." Applicant submits that, as explained above with respect to claims 14-29, Lundquist in view of "general knowledge in the art" does not show all the limitations of claims 1-13.

Applicant submits that all claims are now allowable and respectfully requests reconsideration and allowance of the application.

Respectfully submitted,

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By: [signature]

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